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NATIONAL ENGINEERING AND SCIENCE MANPOWER ACT OF 1982

OCTOBER 5, 1982.—Ordered to be printed

Mr. FUQUA, from the Committee on Science and Technology, submitted the following

REPORT

together with

ADDITIONAL AND MINORITY VIEWS

[To accompany H.R. 7130]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science and Technology, to whom was referred the bill (H.R. 7130) to provide a national policy for engineering, technical, and scientific manpower, to provide for cost-sharing by the private sector in training such manpower, to create a national Coordinating Council on Engineering and Scientific Manpower, and for other purposes, having considered the same, report favorably thereon without amendment and recommend that the bill do pass.

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I. PURPOSE OF THE BILL

During the past several years the Committee on Science and Technology has been made increasingly aware of problems in the nation's ability to provide trained and technically skilled personnel necessary to our continued national economic strength and vitality. Specific areas of concern include: A decrease in engineering faculty with a concurrent increase in engineering enrollment; a decline in the quantity and quality of new graduate engineers and researchers; a decline in the nnumber of science and mathematics teachers at the precollege level; a long-term decline in precollege scientific literacy and an increased need for skilled technicians in various high technology fields. These problems have been identified in various hearings before the Committee, in national studies and conferences, and in individual communications to the Committee. The lack of (1) a comprehensive national policy regarding technical, engineering and science manpower, or (2) a formal means for formulating such a policy and assessing related technical manpower needs, or (3) specific programs designed to implement manpower policies has been widely cited as a significant cause of these problems.

The principal purpose of H.R. 7130 is to establish a broad national policy for engineering, technical, and scientific manpower and to define the role of the Federal Government in solving the national manpower problems just described. The bill establishes a means, the national Coordinating Council on Engineering and Scientific Manpower, for formulating more specific policies, and establishes funded programs designed to solve manpower problems. Another purpose of the bill is to provide a means for cost-sharing, particularly by the private sector, in the programs established under the legislation.

II. BRIEF SUMMARY OF THE BILL

H.R. 7130 provides a comprehensive statement of national policy regarding the Federal role for engineering, technical, and scientific manpower. The bill establishes within the Executive Branch a Coordinating Council on Engineering and Scientific Manpower for formal Federal and non-Federal joint participation in making policy and program recommendations related to these manpower needs. In addition, the bill promotes cost-sharing in the development of technical manpower by providing for the creation of a special discretionary Engineering and Science Manpower Fund within the National Science

Foundation. The bill further provides for specific programs to be established within the National Science Foundation. These include programs for: Modernization of instructional instrumentation; technician training at two-year and community colleges; young faculty research awards; and precollege math and science teacher improvement. The following amounts are authorized for the various provisions in the bill: $51 million in fiscal year 1983; $100 million in fiscal year 1984 and fiscal year 1985; and $125 million in fiscal year 1986 and fiscal year 1987. The Fund and Council both terminate after five years.

III. BACKGROUND AND NEED FOR THE LEGISLATION

In hearings before the Committee on Science and Technology, testimony has focused on a number of concerns regarding technical, engineering, and scientific manpower needs. Much of this has centered on issues in the general areas of precollege education, post-secondary education, and public literacy and technician training. The following provides some discussion of the facts and concerns in each of these areas. (The statistics and data cited, unless otherwise noted, come from testimony before the Committee in the hearings listed in Section VII of this report.)

Precollege education

In dealing with the engineering and scientific manpower problem it is necessary to address the underlying causes. One such cause is the present weakness of primary and secondary school science and mathematics education. The structure of science and mathematics education can be seen as a pyramid with the primary and secondary schools at the base and colleges and universities producing engineers and scientists at the top. If the base is weak and underproductive, the entire system will be unreliable. Further, the failure to develop a strong base in mathematics and science at the precollege levels decreases the resource pool of people from which the new engineers and scientists can be drawn. This is of particular concern given current demographic trends. In short, our nation's future in engineering and scientific manpower is determined during the precollege years.

Today, only thirteen percent of all high school graduates are prepared for the engineering curriculum in college, compared with twenty-eight percent in 1972. One of the many reasons for this is that high school requirements for math and science were lowered during the 1970's, as were the science and math requirements for college admission. Further, every standardized test used to measure science and math capabilities has shown a steadily declining level of achievement in the last ten years. Fewer secondary school students are taking fewer courses in math and science than in years past. At a recent National Academy of Sciences convocation Professor Paul Hurd of Stanford University pointed out that only thirty-four percent of recent high school graduates have taken three years of math. Of these, only eight percent have taken calculus, and less than twenty percent of high school graduates have taken three years of science. Of the forty percent of high school graduates who took the college preparatory program, fifty-five percent have taken three years of math, and forty-one percent have taken three years of science. Of studies indicate that

forty-eight percent of high school students were enrolled in at least one science class in the academic year of 1976–1977. In contrast, fifty-nine percent were enrolled in at least one science course in the academic year 1960–1961.

Comparatively, U.S. high school students spend only a fraction of the amount of time in math and science spent by their counterparts in other countries such as Japan and West Germany. For instance, in the United States, only one-sixth of all high school students have taken junior or senior math courses and two-thirds of U.S. high schools require only one year of math and science for graduation. These facts are even more dramatic when considered in light of the great strides in technology made by Japan and the fact that Japan has mounted a serious threat to the United States as the world's preeminent technological power.

The crisis in precollege math and science education is also seen in the quality and quantity of precollege teachers. According to the National Education Association, the supply of math teachers equaled only seventy-eight percent of the current demand, with twenty-two percent of the available teaching posts left vacant. In a survey taken by the National Governors Association, forty-three out of forty-five states reported a shortage or critical shortage of math teachers, forty-two states reported a shortage of physics teachers, and thirty-eight states reported a shortage of chemistry teachers. This problem is growing worse year by year. The National Science Board reports that experienced science and math teachers left their jobs at the rate of four percent in 1980 and 1981, with another twenty-five percent expressing the intention to leave in the near future. If this trend continues, the nation will suffer a net loss of thirty-five percent of its science and math teachers by 1992. This trend is also reflected in the fact that the average age of science teachers responding to a recent survey was forty-one, an indication that an insufficient number of new and young science teachers are entering the profession.

The precollege math and science education picture is further clouded by an apparent decline in the quality of teachers. Among newly employed science and math teachers, fifty percent were judged by their principals as being unqualified to teach their subject. In addition, since 1972, there has been a seventy-seven percent decline in the number of qualified secondary school math teachers nationwide who were prepared in college teacher programs. Twenty-six percent of all math teaching positions are filled by non-certified teachers and close to twenty percent of all high school science teachers were non-science majors in college. Of all the present science and math teachers, seventy-nine percent have not completed a ten hour workshop or course in their subject area in over ten years, sixty-nine percent have never attended a computer course and forty percent have not attended a course or workshop since they began teaching.

The reasons for the decline in the number of qualified math and science teachers are complex. Of those cited in testimony, many are related to the level of salaries and lack of distinction between those teachers who excel and those who do not. Looking at salary, the average salary of a new, graduating teacher is between $9,000 and $10,000 annually, whereas $18,000 to $30,000 is commanded by those entering scientific or technically oriented professions. Further, teachers with

good qualifications in math or science are being enticed to accept jobs in industry where the salary is certainly better. Also, extra burdens such as the need to seek summer employment, participate in mandatory extracurricular activities or contend with unpredictable school administrators, parents, students and other teachers, are eliminated in the private sector. Finally, many have noted that the public attitude toward teachers and teaching has declined to such an extent that most would counsel young potential teachers to seek other careers.

Thus, the nation is confronted with a declining trend in both the overall quality and the availability of precollege science and math teachers. Such a trend will have a profound effect on the nation's future supply of qualified scientists, technicians and engineers needed to operate our economy in years to come.

Post secondary education

College and University schools of engineering suffer from a critical shortage of qualified faculty. Two thousand full time faculty positions, representing ten percent of the total engineering faculty positions, are vacant and most have been left vacant for at least one year. Such reductions in numbers of faculty have led many engineering schools to limit their enrollments, thus exacerbating the problem of providing sufficient numbers of appropriately skilled engineers. In the 1979–1980 academic year alone, four hundred engineering faculty (three percent of all faculty positions) left their positions for new jobs in industry. Moreover, the difference between starting salaries in industry and the average faculty salary has swelled to thirty-three percent over the last four years.

The antiquiated condition of instructional and research equipment in university laboratories is another reason many faculty members migrate from the teaching profession to industry. Much of the equipment is of 1950's vintage and cannot compare to the state-of-the-art equipment now used in private industry. Visiting scientists from technologically advanced countries have expressed their surprise with the deteriorated condition of scientific equipment in university laboratories. Dean Daniel C. Drucker of the University of Illinois School of Engineering, along with many of his counterparts at other academic institutions, described the proportions of the problem when he estimated that an investment of one billion dollars would be necessary to upgrade university laboratories to a level of quality equal to that of private industry. Testimony by the National Science Foundation placed the estimate as high as $4 billion. As the nation progresses in new technological fields such as design automation, process control, or microfabrication, the research and instructional equipment will be highly expensive and prone to quick obsolescence. Special attention must be given to problems adversely affecting undergraduate and graduate engineering and science faculty.

Since 1972, there has been a fifty-four percent decline in the number of Ph.D.'s in engineering awarded yearly to U.S. nationals while the number of Ph.D.'s awarded to foreign students has more than doubled. In 1972, 3,220 U.S. nationals earned Ph.D.'s in engineering, but only 1485 achieved Ph.D.'s in 1980. On the other hand, the number of foreign nationals awarded Ph.D.'s in engineering rose from 1555 to 3390 between 1972 and 1980. Thus, a serious decline in the number of ad-

vanced engineering degrees earned by U.S. citizens depletes our pool of engineering faculty. At the same time, our potential economic competitors are sending more students to the United States for advanced scientific and engineering degrees.

During the course of the hearings on this legislation by the Science, Research and Technology Subcommittee, witnesses stressed the point that national economic vitality and growth are directly related to the training of graduate students, especially in technical areas. Thus, the drop in the number of U.S. students obtaining advanced engineering degrees will threaten the future availability of a sufficient number of undergraduate and graduate faculty. If the current trends in post-secondary science and engineering education continue, the nation will be caught in a cycle that will ultimately result in a steady decline in the number of technically competent people for an economy that is growing more and more technically oriented.

Public literacy and technician training

The changing nature of America's work force is another major factor bearing upon the transition to a more technologically oriented economy. Over the next twenty-five years, the changes in our human resources will have a decisive effect on our economic future. When combined with the current trends at all levels of education, these demographic changes must be dealt with if we are to have an adequate supply of technically skilled workers.

The most pronounced change in the labor force can be seen in the future reduction in the number of blue collar manufacturing jobs. Currently, twenty million workers, twenty percent of the labor force, are employed in blue collar manufacturing. Most projections for the year 2005 indicate that only seven to twelve million workers, or five to ten percent of the work force, will be engaged in blue collar manufacturing jobs. Some of the developments that bring about this reduction in the manual manufacturing work force can be seen in demographic changes.

Almost everyone who will function in the American economy in the next twenty years has already been born. This pool of workers for the turn of the century is different in ways that will change the direction of the economy. First, there has been a thirty percent reduction in the birthrate. The "baby bust", which started in 1960, will cause a thirty percent reduction in the number of people reaching working age over the next two decades. Thus, the number of people newly available for traditional blue collar manufacturing jobs will be one-third smaller. The number of workers aged 16–25 will shrink by sixteen percent in this decade alone. Second, during the next twenty years the number of people with an education level beyond high school will double. In 1940 high school graduates comprised twenty-five percent of the work force, whereas sixty-eight percent of the work force in 1979 has graduated from high school. Today, better than one-half of the men and women entering the work force have stayed in school beyond high school. Their expectations in life as well as capabilities are higher than assembly workers of the past who had a lower level of education. Many experts feel that manufacturing jobs will not appeal to a more highly educated work force. In order to respond to this trend, the U.S. economy will have to create fifty percent more jobs for educated people than ever before. Employment opportunities will have to come from "knowledge jobs."

Third, the work force is becoming more heterogeneous. Women will continue to constitute a larger percentage of the labor pool. In 1960, women represented thirty-seven percent, whereas in 1982, fifty percent of the total number of workers are women. In the next decade, two-thirds of all new entrants into the economy will be women. In education, more women than men are enrolled in college and a growing proportion of women is working toward advanced degrees.

These and other demographic changes as well as technological changes make it necessary for industry, academia and government to respond in such a way as to provide tomorrow's economy with the necessary technical training. The Committee believes that a major focus on new technician training or retraining of the present workforce is critical as the technologies and economy shift. Certainly some of these dislocations in the workforce can already be seen as whole industries such as the steel, automotive and industrial processing industries are cut back or eliminated. Such training or retraining will need to emphasize computer and information technology, electronics, communications, robotics and other advanced technology areas.

IV. EXPLANATION OF THE BILL

H.R. 7130 has four principal thrusts, which are elaborated below. These are:

(1) The establishment of a comprehensive Federal policy of engineering and science manpower;

(2) The establishment by the President of a seven-member Coordinating Council on Engineering and Science Manpower to provide a focal point for policy regarding engineering, science and technical manpower problems;

(3) The creation of a special matching Fund for Engineering and Science Manpower to be administered through NSF with policy direction from the Council; and

(4) The establishment of four specific programs to be carried out by NSF: Modernization of instructional instrumentation; technician training at two-year and community colleges; young faculty research awards; and precollege math and science teacher improvement.

Federal policy on engineering and science manpower

The bill provides for a continuing national policy "to maintain an adequate supply of technical, engineering and scientific personnel to insure the technological strength and security of the Nation". Although the organic acts for the Office of Science and Technology Policy (42 U.S.C. 6601) and the National Science Foundation (42 U.S.C. 1861) make references to federal responsibility regarding "science education" and "national science and technology policy," insufficient attention has been explicitly paid by these organizations to a clear policy for technical, engineering and science manpower. Because of the failure to adequately address the question of such policy, the role of the Federal Government in dealing with these manpower issues has become increasingly unclear. The legislation seeks to clarify the Federal role in technical, engineering and scientific education and manpower.

The intent of the bill is that the policy of the Federal Government and its responsibility to provide the necessary leadership and guidance in carrying out that policy be clearly enunciated. Among those responsibilities are: the identification of technical, engineering and scientific human resource needs; establishment and maintenance of the means for continually assessing the country's manpower needs; provision of leadership and coordination of public and private efforts to address those needs; assistance to universities and other higher educational institutions in promoting the quality of training for graduates in science and engineering; and, finally, encouragement of the use of private sector funding to meet the needs of research and development as well as technical, engineering and science manpower needs.

The bill provides that individual Federal agencies or departments have the authority to establish programs in training and education compatible with the technical, engineering and scientific manpower needs of those agencies or departments. Under this provision such programs, if proposed to the Office of Management and Budget, could not be automatically rejected for lying outside the mission of the individual agency or department. The bill provides, however, that any proposal for such programs be submitted to the Office of Science and Technology Policy (OSTP) and the Coordinating Council established in the bill for review. Further, Congress would have the normal budgetary review and oversight authorities to exercise in either approving or rejecting such proposals before implementation.

Finally, the bill states unequivocally that the OSTP maintains the primary responsibility for developing policies for the Federal support of research and development and of technical, engineering and science manpower. The Committee intends that the Coordinating Council established by the bill and discussed in the next subsection of this report work closely with OSTP in exploring and analyzing related Federal programs, initiatives and policies.

Coordinating Council on Engineering and Science Manpower

H.R. 7130 calls for the establishment and maintenance by the President of a special Coordinating Council on Engineering and Science Manpower. The Council shall consist of seven members to be appointed by the President, four of whom shall come from the private sector. The membership should encompass, to the extent possible, a wide diversity of interested sectors, including industry, academic institutions of higher learning, including undergraduate and graduate institutions, elementary and secondary education and appropriate national and state organizations. The President shall determine the ultimate organizational location, leadership and composition of the Council, although it would seem reasonable that the Director of OSTP, NSF and OMB be closely involved in the activities and direction of the Council.

The Committee intends that the Council act as the focal point in establishing Federal policy in technical, engineering and science human resources and for providing the leadership and coordination necessary to implement those policies. The Council has the responsibility to work collaboratively with OSTP, NSF, OMB and other Federal agencies and Departments in developing such coordination and to assist and advise the President in recommending and establishing policies and programs in this area. It is also responsible for montioring and assessing the needs for trained technical, engineering and scientific personnel

needed by industry, academia, the military and the Government as well as for encouraging the overall quality of science and math education at all levels. The Committee further intends that the Council work to assist OSTP in carrying out its responsibilities concerning long-range technical manpower assessments and policy recommendations.

In granting authorities to the Council, the Committee does not intend that the Council be established as a large, intrusive, bureaucratic organization. Rather, the Committee expects that the Council will take advantage of such information, data and studies as well as analytical and assessment capabilities as currently exist in NSF, OMB, or other Federal or private organizations. The Committee further does not intend that the Council become embroiled in restudying the problems of technical education or manpower, but to take steps to implement programs and recommend actions to deal with the concerns clearly identified by existing reports and commissions and in this legislation. Finally, the Council will terminate five years after enactment unless reauthorized by Congress.

Matching fund for engineering and science manpower

A special matching Fund for Engineering and Science Manpower is established within NSF by the bill. The Committee intends that the Fund be used in a discretionary manner to encourage cost-sharing by the Federal sector with such private or other public sector monies that would be available. In administering the Fund the Foundation will follow the policy guidance of the Council. In particular, attention is called to taking into account the manpower situation in specific job categories or academic disciplines. The Federal participation in any individual grant cannot exceed 50 percent, although it is anticipated that Federal participation could be much less. The Committee further intends that the Fund be used to initiate programs or actions which, upon subsequent positive evaluation, would seek full and more permanent funding from other appropriate sources.

One example of a program area that might be supported by the Fund is computer-aided learning. Though mililons of Federal dollars have been spent on developing software for computer-aided learning, and proposals have been made for spending millions of dollars in distributing computers to primary and secondary schools, little or no effort has been made to bring computer software and hardware together at the teacher and classroom level. The Committee believes it would be reasonable to use the Fund to initiate a pilot program or programs to support research on methods to help the teacher to incorporate the sophisticated but otherwise useless hardware into the classroom. Such programs could be carried out in conjunction with a number of schools or school districts in a number of states or geographical regions. The seed money would be matched by industry, state or local governments as appropriate. After evaluation at the end of the programs the information and training methodologies could be made available nationwide.

Similar examples can be envisioned in using the Fund for computer-aided learning of math and science in institutions of higher education or two-year and community colleges. Use of telecommunications, satellite TV and other advanced techniques could also be explored and supported through the Fund to provide access to technical training and education in critical professions or disciplines. Such a "national

university" concept could take advantage of faculty and expertise available in only a few universities or reigons and bring them to the workplace or to other colleges and universities throughout the country. Again, industry and other funding sources would provide important cost-sharing in such enterprises.

The Fund has the potential to play a key role in the recruitment and maintenance of a high quality teaching and research faculty in our nation's engineering schools. Programs might be developed with the private sector to encourage and permit university engineering faculty to alternate periods of teaching with industrial opportunities, to encourage research and development engineers from the private sector to spend one or two years teaching on university faculties, to support distinguished professorships, and to provide salary support of the new young faculty badly needed in overburdened departments of engineering. These programs would all be conducted on a cost-sharing basis, and, if carefully prepared and well managed, could go far to encourage more engineers to pursue a graduate education and university teaching as an attractive and rewarding career path.

In addition to the Engineering and Science Manpower Fund a number of specific programs are established within the bill. These are as follows:

(1) *Program for Modernization of Instructional Equipment.*—A special program to provide grants to primarily undergraduate educational institutions for the modernization of instructional equipment is created within the National Science Foundation. The Committee intends that the grants made under this program be made on a competitive, cost-effective basis with priority and emphasis given to the needs in engineering and technological education and training at the undergraduate level and in areas of science and technology determined of high importance by the Foundation. The Committee intends that the program focus mainly on the modernization of instructional equipment and facilities at the primarily undergraduate institutions so that their programs in technology, engineering and the sciences might be improved. The Committee does not intend that instructional equipment and facilities exclude such equipment or facilities which might also be used in the conduct of research. It is understood that often sophisticated research equipment such as electron microscope or X-ray spectrometers is necessary to properly train young researchers or engineers in advanced techniques. It is left to the discretion of the Director of the Foundation to develop further the details of such a program.

(2) *High-Technology Technician Training Program.*—A special program for technician training in two-year and community colleges is established within NSF. Two-year or community colleges refer to two-year post secondary institutions accredited by the appropriate regional Commission or colleges. The Committee intends that the grants made under the authority of this section of the bill will lead to model programs which would provide critically needed, skilled technicians in such high-technology areas as advanced electronics, robotics, computer and information technologies, communications, optics and advanced materials and materials processing.

(3) *Young Investigators Awards Programs.* A Presidential Science and Engineering Young Investigators Awards program is established within NSF. The Committee intends that such a program, directed

to young, untenured but promising faculty in the scientific and engineering fields, encourage the retention of talented and needed young educators within our colleges and universities. The funds used in this program shall be awarded to selected individuals for a period of five years, the first $25,000 in research monies without prior restriction, but an additional $25,000 would be available if appropriate matching funding on a two-to-one basis is found.

(4) *Presidential Science and Mathematics Improvement Program.*—The bill also provides for a Presidential Science and Mathematics Improvement Program to be established within the National Science Foundation. The Committee intends to create through this program a series of in-service training programs to improve the understanding and instructional skills of precollege science and mathematics teachers. The Committee intends that stipends be provided to teachers selected such that the teachers are able to participate in such programs. It is also anticipated that the development of new instructional material at appropriate undergraduate and graduate institutions of higher learning would be a part of the programs developed under the authority of this section. The Committee expects that the Foundation work closely with the various states in developing guidelines and on overall activities conducted in the individual states. The Committee intends that one-half the monies for stipends for individual teachers be obtained from non-federal sources.

V. SECTIONAL ANALYSIS OF THE BILL

Section 1. Short Title: "National Engineering and Science Manpower Act of 1982".

Section 2. Findings and Purposes: This section notes the importance of technical, engineering and scientific manpower to the nation's economic and strategic interests and notes the human resource problems that currently exist in a number of critical areas. The purpose of providing a necessary policy, providing for cost-sharing by the private sector, and creating a Coordinating Council on Engineering and Scientific Manpower is stated.

Section 3. Policy: A policy "to maintain an adequate supply of technical, engineering and scientific manpower to insure the technological strength and security of the Nation" is stated, further requiring the President to:

(1) identify the technical human resource needs;

(2) establish a means for continually assessing the long and short term manpower needs;

(3) establish and promote leadership and coordination for private and public sector activities;

(4) assist universities and colleges in assuring the quality and quantity of graduates;

(5) encourage private sector support.

The bill further provides authority to each Federal agency and department to establish such technical manpower programs as considered necessary but subject to the normal budgetary review of the President and Congress.

The Office of Science and Technology Policy is designated as having the primary responsibility for developing policies for Federal R&D and science, engineering and technical manpower.

Section 4. Coordinating Council on Engineering and Scientific Manpower: A seven member council (four of whom shall come from the private sector) is to be established by the President with the Chairman to be designated by the President.

Section 5. Responsibilities and Authorities of the Council: The Council is primarily responsible for coordinating Federal efforts in engineering and science education and to assist and advise in establishing such initiatives as considered necessary. The Council is further responsible for monitoring and assessing manpower needs; encouraging access into the technical, engineering and science field for minorities and women; and assisting in preparing such long-range assessments and recommendations as mandated.

The Council has the authority to employ up to eight employees, among other authorities for operation.

The Council is established for five years subject to reauthorization at the end of that period.

Section 6. Establishment of Engineering and Science Manpower Fund: A special fund is established to be used on a matching basis with private or public sector funds, as available. The fund shall be administered by the National Science Foundation under the policy direction of the Council.

The fund is established for five years, subject to reauthorization at the end of that period.

Section 7. Compensation of Members of Council and Reimbursements: Members of the Council shall be paid at a rate equivalent to level III of the Executive Schedule; the chairman at level II.

Section 8. National Program for Modernization of Instructional Equipment. Creates a special program for modernization of instructional equipment and facilities within NSF.

Section 9. National High-Technology Technician Training Program: Establishes a high-technology technician training program directed by NSF for two-year and community colleges.

Section 10. Presidential Science and Engineering Young Investigators Awards Program: Establishes a special program within NSF using matching private sector monies to support young untenured but promising scientific university faculty.

Section 11. Presidential Science and Mathematics Improvement Programs: Establishes within NSF a special program to improve the qualifications and skills and improve the retention of precollege science and mathematics teachers.

Section 12. Research Facilities and Manpower Improvement: Establishes a Federal program to promote improvement of university research facilities and science and technical manpower improvement. Authorizes any Federal agency with $100,000,000 or more in basic research monies to establish such programs.

Section 13. Authorization of Appropriations:

(a) Authorizes $1,000,000 for the Council in fiscal year 1983 and such monies as necessary through fiscal year 1987;

(b) Authorizes $20,000,000 for the Manpower Fund in fiscal year 1983 and $40,000,000 in each of the years to fiscal year 1987.

(c) Authorizes $10,000.000 for the instructional instrumentation program in fiscal year 1983, $15,000,000 in fiscal year 1984 and fiscal year 1985, and $20,000,000 in fiscal year 1986 and fiscal year 1987.

(d) Authorizes $5,000,000 for the technician training program in fiscal year 1983, $10,000,000 in fiscal year 1984 and fiscal year 1985, and $15,000,000 in fiscal year 1986 and fiscal year 1987.

(e) Authorizes $5,000,000 for the Presidential science and engineering young investigators awards in fiscal year 1983 and $15,000,000 in fiscal year 1984 and fiscal year 1985, and $20,000,000 in fiscal year 1986 and fiscal year 1987.

(f) Authorizes $10,000,000 for the precollege science and math teacher improvement programs in fiscal year 1983, $20,000,000 in fiscal year 1984 and fiscal year 1985, and $30,000,000 in fiscal year 1986 and fiscal year 1987.

VI. COMMITTEE VIEWS

Cost-sharing

As part of the overall philosophy of H.R. 7130, cost-sharing and collaboration between the Federal Government and non-Federal public and private sectors provide essential elements of the legislation. The Committee feels strongly that the Federal Government should work closely with industry, academia and the state and local governments in exploring imaginative new ways to support initiatives for developing technical, engineering and science manpower. It is clear to the Committee that resolution of the complex problems of our national manpower needs will require each of the concerned sectors to participate and carry their fair share of the costs, as well as other responsibilities. It is for this reason that the Committee has provided for matching monies as an integral part of the discretionary Engineering and Science Manpower Fund and the other specific programs mandated in the legislation.

It is the Committee's views and expectation that the matching funds from the non-Federal sector come in large part from the industrial and business sectors which have the most striking need for trained personnel. However, the use of state and local government support should not be neglected, particularly in consideration of relevant precollege programs and undergraduate programs. Recognizing that the diverse needs and interests of the Federal sector cannot always be met by funds available in the National Science Foundation, the Committee has also provided for flexibility in the legislation to allow for use of interagency or interdepartmental matching funds where it is found appropriate and necessary.

The Committee recognizes that the monies made available under this legislation, when compared with the $200 billion annual costs in precollege public education alone, cannot resolve all the problems and issues currently envisioned. Rather it is the Committee's view that the monies made available under the special Engineering and Science Manpower fund be considered as "seed" money to evaluate particular initiatives which, if proved successful, would find more permanent funding from appropriate Federal or non-Federal institutions.

Policy formulation

The Committee feels strongly that comprehensive policy formulation, decisionmaking, and coordination of the Federal efforts in this area is critical to the intent and proper implementation of this legislation. While various Federal organizations such as the National Science Foundation and the Office of Science and Technology Policy have

broad autnorities and responsibilities to address technical, engineering, and science manpower issues, the Committee feels that other priorities and competing responsibilities have caused diminished attention by existing structures to such issues. It is for this reason that the Committee believes that a single Federal organizational entity should have the major responsibility for focusing on these critical issues, monitoring the nation's manpower needs and making the necessary assessments and recommendations for policies and programs, as well as providing for coordination of related Federal efforts and activities. The Coordinating Council on Engineering and Science Manpower is established to be such a focal point, though it is expected to work closely with OSTP in carrying out its responsibility.

The Committee has intended that the legislation define the structure, composition, location, and leadership of the Council in such a way as to give the President maximum flexibility in its establishment. Key to the success of such a Council is the active participation by the non-Federal, private sector. It is the Committee's view that just as funding and costs of manpower programs should be shared between the Federal and non-Federal sectors, it is also felt that those sectors should have the opportunity to participate formally in formulating policies and programs to address the manpower issues. The Committee views the Council as providing that essential opportunity, an element largely lacking in our present system. Obviously, such direct participation will be important to helping coordinate not just the Federal programs but, as well, the various non-Federal programs now emerging and being provided by industry, the business sector and others. The Committee intends that the President should consult with a broad range of institutions, associations, and individuals during the nomination process. It is anticipated that academic membership on the Council will include representatives from research universities, as well as undergraduate institutions with major programs in engineering and the sciences.

In calling for the creation of the Coordinating Council, the Committee does not intend that further studies, analyses and data-gathering be substituted for real action. It is the Committee's view that much of the information regarding the manpower problems already exists, at least to the point that obvious specific actions can now be undertaken. While further analysis and data-gathering should continue, principally within NSF and other organizations already conducting such efforts, the Committee feels that the Federal Government can begin to address areas of concern with action programs of already proven value. These include precollege science and math teacher training, such as the prior NSF summer institutes prgram, and other such programs.

Balance in programs and policy

In establishing policy and making recommendations concerning manpower issues, the Committee believes that a balance must be maintained between action directed towards precollege, undergraduate and graduate programs. This balance involves precollege versus post secondary programs, and these are questions of near-term concern versus those of the long-term. In addressing actions toward strengthening specific fields of undergraduate and graduate engineering and science research enterprises, the focus should be placed on readily identifiable short-term needs of the next two to five years. Obviously, precollege

education is aimed at more long-term concerns extending into the next century, though actions just as obviously must be begun now to avoid a further worsening of the problems. Engineering and science faculty recruitment and retention is also of immediate importance to deal with the long-term consequences. Finally, technician training and retraining encompasses both a short- and increasingly long-term concern. Each of these areas must be carefully evaluated and new strategies developed as need and information dictate. Thus, flexibility for such change must be incorporated into the original programs carried out in implementing this legislation. The Committee believes—while providing for specific actions into the form of specified programs now—that such flexibility will allow for incorporation of other actions which might result from the ongoing study of the National Science Board Commission on Precollege Education in Mathematics, Science and Technology.

Women and minorities

It is the Committee's view that women and minorities represent an underutilized resource in meeting the nation's technical, engineering and scientific human resource needs. In following with the Committee's continuing position in this regard the Committee directs that each of the programs established under the provisions of this legislation provide for specific attention to incorporating women and minorities into the technical, engineering and scientific human resource pool.

Information and communication technologies in education

Testimony before the Committee has reiterated that information and communication technologies have the potential to increase educational productivity for the learner as well as the teacher. Thus, in carrying out the intent of the Act, the Committee recommends that the plan for the science and mathematics improvement program include the improvement of teachers' science and mathematics competence by recognizing the potential contributions of information and communication technologies to learning, and the enhancement of instruction through the use of these technologies. Information and communications technologies could also enhance the development and evaluation of the instructional materials resulting from the science and mathematics improvement program.

Technologies such as television and radio broadcast, cable, satellite, video recorders and microcomputers can be utilized in the dissemination of appropriate courseware and curricular materials. For example, broadcast media can provide educational components, such as 3-2-1 CONTACT, for use in local curricula and simultaneously provide science and mathematics career information to children of all educational levels. Therefore, the Committee recommends that the plan for the science and mathematics improvement program take into consideration the potential of available technologies to develop and evaluate materials which can be integrated into a wide range of curricula and assist in providing incentives for careers in science and mathematics.

VII. LEGISLATIVE HISTORY OF H.R. 7130

H.R. 7130 was originally introduced as H.R. 5254. That bill was introduced by Mr. Fuqua for himself and Mr. Walgren on December 16, 1981. Mr. Brown of California, Mr. Dymally, Mr. Ertel, Mr. Flippo, Mr. Lujan, Mr. Roe, Mr. Hollenbeck, Mr. Harkin, Mrs. Heckler, Mr.

Glickman, Mr. Young of Missouri, Mr. McGrath, Mr. Wolpe, Mr. Shamansky, Mr. McCurdy, Mr. Fish, and Mr. Ralph Hall of Texas later joined as cosponsors. The bill was referred to the Subcommittee on Science, Research and Technology of the Committee on Science and Technology.

Testimony was heard before the Committee in five series of hearings. The first series, held prior to introduction of the bill and dealing with various engineering manpower concerns, took place in Washington, D.C. on October 6 and 7, 1981. On October 6 the following witnesses testified: Hon. Harrison Schmitt; Dr. Lewis Branscomb, Chairman, National Science Board; a panel comprised of Dr. Robert Frosch, President, American Association of Engineering Societies; Mr. Jack Geils, American Association for Engineering Education; General Robert T. Marsch, Commander, Air Force Systems Command; and Prof. Robert Gaither, Dean of Engineering, University of Florida. On October 7, 1981 the full Committee heard testimony from: Mr. Harry S. Havens, Assistant Comptroller General, General Accounting Office, accompanied by Mary Hamilton and Michael P. McAtee, both of the General Accounting Office; Dr. Frank Press, President, National Academy of Sciences; and Dr. Courtland Perkins, President, National Academy of Engineering.

On December 14, 1981 the Subcommittee held a hearing on the topic of National Engineering and Science Policy at the Middletown Campus of Pennsylvania State University. The following witnesses testified: Dr. Barry Maxwell, Dean, College of Engineering, Bucknell University; Dr. Richard C. Cunningham, Vice President, Pennsylvania State University; Dr. Bernard P. Sagik, Vice President for Academic Affairs, Drexel University; Dr. Herman Branson, President of Lincoln University; and Mr. Sheldon Haas, Institute of Electrical and Electronic Engineers.

On February 11, 1982, the Subcommittee held a hearing in Pittsburgh, Pennsylvania, on the campus of the University of Pittsburgh. University Chancellor Wesley Posvar along with three panels of witnesses representing local universities, colleges and industry presented testimony on the issue of science and engineering education. The following witnesses testified: Jerome Rosenberg, Dean, Faculty of Arts and Sciences, University of Pittsburgh; Daniel Berg, Provost, Carnegie-Mellon University; Kurt C. Schreiber, Acting Dean, Graduate School, Duquesne University; Jonathan Green, President, Green International; George Moore, Director of Engineering and Training, Westinghouse Education Center; Alex Procyk, Vice President, Dravo Corporation; Diane Wakefield, Associate Professor Chemistry, Director of Women in Science, Chatham College; J. Matthew Simon, Department of Natural Science and Technology, Point Park College; and Mr. Andrew Korim, Director of Development and Legislative Liaison, Community College of Allegheny County.

On April 27 and 29, 1982, the Subcommittee held a hearing on H.R. 5254 and gathered testimony from the following witnesses: Hon. John Glenn; Dr. Edward David, President, Exxon Research Corporation; Dr. F. James Rutherford, Chief Education Officer, American Association for the Advancement of Science; Dr. Eugene Zwover, President, American Association of Engineering Societies; Dr. Delbert Tesar, Professor and Director of the Center for Intelligent Machines and

Robotics, University of Florida; Hon. Charles Robb, Governor, State of Virginia; Hon. Ike Skelton; Dr. Douglas Pewitt, Office of Science and Technology Policy; Dr. Sheldon L. Glashow, Harvard University; and Reena Beth Gordon, Westinghouse Scholar, Brooklyn, New York.

On May 7, 1982, the Subcommittee held a hearing at the University of Oklahoma on the issue of secondary math and science education. Two panels of witnesses testified as well as Dr. Harold Huneke, David Ross Boyd Professor of Mathematics and Education, University of Oklahoma. The first panel included: Dr. Richard S. Nicholson, Executive Director, Commission on Precollege Education in Mathematics, Science and Technology, National Science Foundation; Dr. F. James Rutherford, Chief Education Officer, American Association for the Advancement of Science; and Dr. Joseph Lipson, Group Project Director, Training and Education Division, WICAT Systems, Orem, Utah. The second panel included: Mr. Gene Smith, Science Coordinator, Oklahoma State Department of Education; Dr. Don Kellogg, Professor of Education, East Central State University; Dr. Joseph R. Weaver, Administrator of Teacher Testing, Oklahoma State Department of Education; and Dr. Douglas Aichele, Head of Curriculum and Instruction, Oklahoma State University.

On September 15 and 16, 1982, the Subcommittee on Science, Research and Technology met for the purpose of marking up the bill. After discussion, the Subcommittee adopted the bill, as amended. A clean bill, H.R. 7130, was introduced and referred to the full Committee for action.

On September 22, 1982, the Committee on Science and Technology voted unanimously by voice vote to report H.R. 7130 for further consideration by the full House.

VIII. ADMINISTRATION VIEWS

Although the Administration agrees on the importance of science and engineering manpower for the nation's economic vitality and military security, it opposed many of the provisions of H.R. 5254 as originally introduced. Testimony before the Subcommittee on Science, Research and Technology by Dr. Douglas Pewitt, Assistant Director for General Science of the Office of Science and Technology Policy, opposing the bill focused primarily on the Coordinating Council. Dr. Pewitt was concerned that establishing the Council would be creating an unwielding bureaucracy. The Committee, in amending H.R. 5254 to its present form in H.R. 7130, responded to this concern by simplifying the Council and giving the President more flexibility in its implementation. The size of the Counel was reduced from ten to seven members and its organizational location, overall composition and chairmanship left to the discretion of the President.

The Administration has not yet made its views known on the provisions of H.R. 7130 as approved by the Committee on Science and technology.

IX. INFLATION IMPACT OF THE BILL

In accordance with Rule XI, Clause 2(l)(4), of the Rules of the House of Representatives, this legislation is assessed to have no adverse inflationary effect on prices and costs in the operation of the national economy.

X. COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

Pursuant to Rule XI, Clause 2(l)(3), of the Rules of the House of Representatives, under the authority of Clause 2(b)(1) and Clause 3(f), Rule X, the Committee's oversight findings and conclusions are reflected in the recommendations found in the present bill and report.

XI. SUMMARY OF COMMITTEE ON GOVERNMENT OPERATIONS FINDINGS AND RECOMMENDATIONS

Pursuant to Rule X, Clause 2(b)(2), and Rule XI, Clause 2(l)(3) of the Rules of the House of Representatives, no findings or recommendations have been submitted by the Committee on Government Operations for inclusion in this report.

XII. BUDGET ANALYSIS AND PROJECTION

The bill provides for new authorization rather than new budget authority, and, consequently, the provisions of section 308(a) of the Congressional Budget Act are not applicable.

XIII. CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

Pursuant to section 403 of the Congressional Budget Act of 1974 and Rule XI, Clause 2(l)(3) of the Rules of the House of Representatives, the report of the Congressional Budget Office follows:

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, D.C., September 28, 1982.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology, U.S. House of Representatives, Rayburn House Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: Pursuant to Section 403 of the Congressional Budget Act of 1974, the Congressional Budget Office has prepared the attached cost estimate for H.R. 7130, the National Engineering and Science Manpower Act of 1982.

Should the Committee so desire, we would be pleased to provide further details on this estimate.

Sincerely,

RAYMOND C. SCHEPPACH
(For Alice M. Rivlin, Director).

CONGRESSIONAL BUDGET OFFICE—COST ESTIMATE

1. Bill number: H.R. 7130.
2. Bill title: National Engineering and Science Manpower Act of 1982.
3. Bill status: As ordered reported by the House Committee on Science and Technology on September 23, 1982.
4. Bill purpose: The bill establishes a national policy for engineering, technical, and scientific manpower and requires the President to create a seven-member Coordinating Council on Engineering and Sci-

entific Manpower. The bill also establishes a fund for grants to promote and develop the quality of technical, scientific, and engineering manpower resources.

The bill authorizes four new programs intended to modernize instrumentation, promote technical training at two-year colleges, encourage young scientists to establish careers in academic research, and improve the skills and the rate of retention of precollege science and mathematics teachers. All these programs would be administered by the National Science Foundation (NSF).

Section 12 of the bill establishes, in any federal agency with obligations of over $100 million in basic research, a program for the improvement of university research facilities, and science and technical manpower. Guidelines for agency participation must be submitted by the NSF to Congress prior to the submission of the federal budget for fiscal year 1984. A plan developed by NSF shall include provisions which limit the federal contribution to any grant to the amount of funds contributed by the private sector.

5. Cost estimate:

	Millions
Estimated authorization level:	
Fiscal year:	
1983	$51
1984	101
1985	101
1986	126
1987	126
Estimated outlays:	
Fiscal year:	
1983	5
1984	36
1985	76
1986	99
1987	126

The costs of this bill fall within budget function 250.

The above estimate does not include the potential cost of the Section 12 grant program, because no specific amounts are authorized and the extent of the program is not specified in the bill.

6. Basis of estimate: It was assumed for the purposes of this estimate that the bill would become effective early in fiscal year 1983, and that all sums authorized will be appropriated.

The bill authorizes the appropriation of $51 million in 1983 of which $50 million will be for various grant programs created by this bill and $1 million will be for the Council and other non-grant activity. The bill also authorizes $100 million in each of the fiscal year 1984 and 1985, and $125 million for each of the fiscal years 1986 and 1987 for grants. The bill authorizes such sums as may be necessary for 1984 and beyond for the Council and other activities. The CBO estimates that the necessary expenses for the Council's activities will not significantly exceed the $1 million authorized in 1983.

The such sums as may be necessary authorization also covers the grant program established in Section 12. The authorization level is dependent on the plan submitted by the NSF, outlining the extent of grant activity undertaken by federal agencies, and therefore cannot be reasonably estimated.

The estimated outlays for the bill are based on spending patterns experienced by similar NSF grant programs.

7. Estimate comparison: None.
8. Previous CBO estimate: None.
9. Estimate prepared by: Jeff Nitta.
10. Estimate approved by:

JAMES L. BLUM,
Assistant Director for Budget Analysis.

XIV. CHANGES IN EXISTING LAW MADE BY THE BILL AS REPORTED

In compliance with clause 3 of Rule XIII of the Rules of the House of Representatives, no changes in existing law are made by the bill, as reported.

XV. COMMITTEE RECOMMENDATIONS

A quorum being present, on September 22, 1982 the Committee ordered favorably reported the bill, H.R. 7130, by unanimous voice vote and recommends its approval.

XVI MINORITY VIEWS

COMMITTEE REPORT ON THE NATIONAL ENGINEERING AND SCIENCE MANPOWER ACT OF 1982 (H.R. 7130)

There are few issues more fundamental to America's scientific and techniological enterprise than the bedrock of science education. The Committee's hearings on the science education issue have always been very enlightening and certainly bipartisan. In an economy headed towards 50% of its GNP being generated by high technology industries before the end of the 1980s, we cannot afford to sit idly by while science illiteracy spreads across the country like a debilitating plague. Based on these hearings, the Committee has determined that a very real problem exists.

The increasing levels of science illiteracy pose a danger to our national prosperity. If the emerging work force is not adequately prepared for the coming decade of technology, they will not only become functionally illiterate, but our very ability to excel in scientific and technological endeavors will be threatened. At stake is the competitiveness of American products in international markets, reduced productivity in the electroncis/information processing industry, and a diminished national security capability.

The Minority members are convinced of both the severity of the problem and the need to act quickly. Our colleague, Mrs. Heckler, has developed at very effective piece of legislation, "The National Science and Technology Improvement Act" (H.R. 6930), that provides specific programs of convincing effectiveness. We concur with Mr. Heckler's approach to the problem and note that the Administration has been discussing similar approaches with very positive results. It is also significant that Senator Schmitt has introduced companion legislation in the Senate.

H.R. 6930 embodies the greatest economy in a period of large federal deficits, and at the same time outlines specific programs with assured productivity. Due to the short time left in this session, it is clear that the Heckler approach, with a Senate companion and Administration approval imminent, is the only bill that can pass both houses and receive the President's signature this year. We are opposing H.R. 7130 because its chances of passage in this Congress are slim at best. Despite the fact that the bill incorporates the important programs outline in Mrs. Heckler's bill (H.R. 6930), the "extra baggage" loaded into the legislation is excessively expensive and of questionable effectiveness.

With the science education problem defined as well as it is, another federal council with a $180 million slush fund, as set up in H.R. 7130, is the last thing this country needs. Specific programs with proven effectiveness are urgently needed, and are provided in the Heckler bill, H.R. 6930. It is unfortunate that amendments to H.R. 7130

intended to make it equally effective were not supported by our other colleagues on the Committee.

In short, we oppose H.R. 7130 not because we disagree with the critical science education problem at hand, but because the bill is too expensive and ensures that nothing will be accomplished this Congress. There simply isn't time to iron out all the differences between this bill and what the Senate and Administration are willing to support. It is unfortunate that the Committee has decided on this course. We oppose this Committee action and view with considerable regret the rejection of the better alternative, H.R. 6930.

LARRY WINN, Jr.
BARRY M. GOLDWATER, Jr.
HAMILTON FISH, Jr.
ROBERT S. WALKER.
EDWIN B. FORSYTHE.
WILLIAM CARNEY.
F. JAMES SENSENBRENNER, Jr.
VIN WEBER.
JUDD GREGG.
RAYMOND J. MCGRATH.
JOE SKEEN.
BILL LOWERY.

XVII. ADDITIONAL VIEWS BY HON. MARGARET M. HECKLER

The action this committee takes on the science education problem may well be the most important function it accomplishes this session. Few of the issues brought before the committee, under the outstanding leadership of Chairman Don Fuqua and Subcommittee Chairman Doug Walgren, have been so well documented. Virtually everyone familiar with the data is convinced with the need for strong and immediate action. It is also clear that some federal involvement will be necessary to provide leadership and a policy focus. I think that members on both sides of the aisle would agree with this.

Earlier this year, I introduced legislation, along with Senator Harrison Schmitt in the Senate, to address the problem. The bill, through in-service training, seeks to improve qualifications of our secondary science and math teachers, and provides research grants to encourage college science, engineering and math faculty to stay on the job. In addition, it authorizes federal agencies with large R&D budgets to support, in conjunction with the private sector, university research efforts through grants for equipment, facilities, fellowship, scholarships, or other means.

Senator Schmitt and I have taken several very specific approaches that we feel are effective and appropriate for the federal government. The Administration has sought to reduce funding for science and math education, most evident in the recent elimination of the Science and Engineering Education directorate at the National Science Foundation. It is therefore all the more important that all members of Congress show support for new legislation, indicating our continued leadership in an area so vital to the nation's continued prosperity.

The approaches used in my bill are narrow in scope, but I feel they are substantial in impact. These same approaches have been discussed by the President's Cabinet Council on Human Resources, and I expect endorsement of these approaches in the near future.

During the subcommittee markup of H.R. 5234, Chairman Walgren accepted my amendment to include the programmatic portions of my bill into the committee bill (see sections 10–12 of H.R. 7130). In the spirit of bipartisan cooperation that regularly prevails on the Science and Technology Committee, I subsequently joined Chairman Fuqua and Mr. Walgren as an original co-sponsor of H.R. 7130.

However, I do feel that my original bill (H.R. 6930) stands a better chance of final success since the Administration wants to take a limited, specific, approach and because of Senator Schmitt's strong support of companion legislation in the Senate. This is why I supported the efforts in subcommittee and full committee markup to substitute my bill (H.R. 6930) for the committee bill (H.R. 7130).

Nevertheless, I do feel that H.R. 7130 is a good bill. The programs it outlines, primarily due to the stroong private sector involvement, represent a significant step in the right direction. It is unfortunate that the "step" may in fact be too large for many of my colleagues in the House. Should this prove to be true on the House Floor, I will offer my more limited approach (H.R. 6930) as a possible substitute.

MARGARET M. HECKLER.

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